

Status of laser spectroscopy of metastable antiprotonic helium atoms at CERN

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The ASACUSA collaboration carries out laser spectroscopy of metastable antiprotonic helium atoms ($\bar{p}He^+ = \bar{p} + He^{2+} + e^-$) at CERN's Antiproton Decelerator facility [1-5]. This is a three-body Coulomb system composed of a helium nucleus, an electron, and orbital antiproton. CERN has recently commissioned the ELENA ring, which produced cooled beams of antiprotons with >100 times higher emittance than before. We propose to utilize the unprecedented high-quality beam of this new facility and the latest laser metrology techniques to carry out sub-Doppler two-photon laser spectroscopy of narrow resonances of $\bar{p}He^+$ with a far higher precision than before. These experiments allow the antiproton-to-electron mass ratio to be determined [4]. Limits may be established on exotic forces that may arise between the constituent particles. A new antiproton beamline with several special features was constructed and commissioned; a sophisticated laser system is now being developed.

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